

What is claimed is

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1. An information processing device which reads,  
buffers, decodes and executes instructions from an  
5 instruction store portion by pipeline processing,  
comprising:

an instruction reading request portion which assigns  
a read address to said instruction store portion;

an instruction buffering portion including a  
10 plurality of instruction buffers which buffer instruction  
sequences read from said instruction store portion;

an instruction execution unit which decodes and  
executes instructions buffered by said instruction  
buffering portion;

15 a branching instruction detection portion which  
detects a branching instruction inside the instruction  
sequence read from said instruction store portion; and

a branch target address information buffering portion  
including a plurality of branch target address information  
20 buffers which, when said branching instruction detection  
portion has detected a branching instruction, buffer the  
branch target address information for generating the branch  
target address of said branching instruction;

wherein:

25 when said branching instruction detection portion has  
detected a branching instruction, either the branch target  
address information of the branching instruction is stored

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in one of the plurality of branch target address information buffers, or the branch target instruction sequence of said branching instruction is stored in one of said plurality of instruction buffers in addition to the storing in said  
5 branch target address information buffer.

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2. An information processing device which reads, buffers, decodes and executes instructions from an instruction store portion by pipeline processing,  
10 comprising:

an instruction reading request portion which assigns a read address to said instruction store portion;

an instruction buffering portion including a plurality of instruction buffers which buffer instruction sequences read from said instruction store portion;  
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an instruction execution unit which decodes and executes instructions buffered by said instruction buffering portion;

a branching instruction detection portion which  
20 detects a branching instruction inside the instruction sequence read from said instruction store portion; and

a branch target address information buffering portion including a plurality of branch target address information buffers which, when said branching instruction detection  
25 portion has detected a branching instruction, buffer the branch target address information for generating the branch target address of said branching instruction;

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wherein:

the first instruction sequence being processed is stored in either one of the first or second instruction buffer and when said branching instruction detection  
5 portion detects a branching instruction inside said first branching instruction sequence, a second instruction sequence of the branch target is stored in the other one of the first or second instruction buffers in accordance with the branch target address information of said  
10 branching instruction;

the branch target address information of the next branching instruction inside said first instruction sequence is stored in either one of the first or second branch target address information buffer; and

15 the branch target address information of the branching instruction inside said second instruction sequence is stored in the other one of said first or second branch target address information buffer.

20 3. The information processing device as claimed in Claim 2 wherein, in the state in which said first instruction sequence being processed is stored in either one of said first or second instruction buffer, the second instruction sequence of the branch target of the branching instruction  
25 inside said first instruction sequence is stored in the other one of said first or second instruction buffers, the branch target address information of the next branching

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instruction inside said first instruction sequence is stored in said first branch target address information buffer and the branch target address information of the branching instruction inside said second instruction  
5 sequence is stored in said second branching address information buffer;

if the execution of the branching instruction inside said first instruction sequence has resulted in branching, said first instruction sequence and the branch target  
10 address information of the next branching instruction inside said first instruction sequence are invalidated;

the third instruction sequence of the branch target of the branching instruction inside said second instruction sequence is stored in one of said first or second instruction  
15 buffer, in accordance with the branch target address information which have been stored in the other one of said first or second branch target address information buffer; and

the branch target address information of the next  
20 branching instruction inside said second instruction sequence is stored in one of the first or second branch target address information buffer, and the branch target address information of the branching instruction inside said third instruction sequence is stored in the other one  
25 of said first or second branch target address information buffer.

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4. The information processing device as claimed in Claim 2 wherein, in the state in which said first instruction sequence being processed is stored in either one of said first or second instruction buffer, the second instruction sequence of the one of the branch target of the branching instruction inside said first instruction sequence is stored in the other one of said first or second instruction buffer, the branch target address information of the next branching instruction inside said first instruction sequence is stored in said first branch target address information buffer and the branch target address information of the branching instruction inside said second instruction sequence is stored in said second branching address information buffer;

if the execution of the branching instruction inside said first instruction sequence has not resulted in branching, said second instruction sequence and the branch target address information of the branching instruction inside said second instruction sequence are invalidated;

the fourth instruction sequence of the branch target of the next branching instruction inside said first instruction sequence is stored in one of said first or second instruction buffer, in accordance with the branch target address information which have been stored in the other one of said first or second branch target address information buffer; and

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branching instruction inside said first instruction sequence is stored again in one of said first or second branch target address information buffer, and the branching address information of the branching instruction inside  
5 said fourth branching instruction sequence is stored in the other one of said first or second branch target address information buffer.

5. The information processing device as claimed in  
10 Claim 1 wherein, in response to a single instruction read request from said instruction reading request portion, a plurality of consecutive instructions from said read address are read from said instruction store portion and buffered in said instruction buffering portion.

6. An information processing device which reads, buffers, decodes and executes instructions from an instruction store portion by pipeline processing, comprising:

20 an instruction reading request portion which assigns a read address to said instruction store portion;

an instruction buffering portion including a plurality of instruction buffers which buffer instruction sequences read from said store portion;

25 an instruction execution unit which decodes and executes instructions buffered by said instruction buffering portion;

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a branching instruction detection portion which detects a branching instruction inside the instruction sequence read from said instruction store portion, and detects branching prediction information of the branching instruction;

a branch target address information buffering portion including a plurality of branch target address information buffers which, when said instruction detection portion has detected a branching instruction, buffer the branch target address information for generating the branch target address of said branching instruction;

wherein:

when said branching instruction detection portion has detected a branching instruction, either the branch target address information of the branching instruction is stored in one of said plurality of branch target address information buffers, or the branch target instruction sequence of said branching instruction is stored again in one of said plurality of instruction buffers in addition to the storing in said branch target address information buffer.

7. An information processing device as claimed in Claim 6 wherein, whether said branch target address information buffering portion buffers the branch target address information of said branching instruction is determined in accordance with the branching prediction

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information of the branching instruction which is detected  
by said instruction detection portion.

8. The information processing device as claimed  
5 in Claim 6 wherein, whether said instruction buffering  
portion fetches the branch target instruction sequence of  
said branching instruction is determined in accordance with  
the branching prediction information of the branching  
instruction which is detected by said instruction detection  
10 portion.

9. The information processing device as claimed in  
Claim 6 wherein, if said branching instruction detection  
portion predicts with a prescribed high level of  
15 probability that the branching instruction will not branch,  
said branch target address information buffering portion  
does not fetch the branch target instruction sequence of  
said branching instruction.

10. The information processing device as claimed in  
Claim 6 wherein, when said branch target address  
information buffering portion has buffered branch target  
address information of a first branching instruction, if  
said branching instruction detection portion has detected  
25 a second branching instruction which has a greater  
possibility of branching than said first branching  
instruction, said branch target address information

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buffering portion invalidates the branch target address information of said first branching instruction and buffers the branch target address information of said second branching instruction.

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11. The information processing device as claimed in Claim 6 wherein, when the instruction buffer of said instruction buffering portion is empty, if a first branching instruction having a first branching possibility is detected by said branching instruction detection portion, a branch target instruction sequence of said first branching instruction is not fetched to said instruction buffering portion and said branch target address information buffering portion buffers the branch target address information of the first branching instruction, and if said branching instruction detection portion has detected a second branching instruction which has a second branching possibility which is higher than said first branching possibility, a branch target instruction sequence of said second branching instruction is fetched to said instruction buffering portion.

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12. An information processing device comprising:  
an instruction fetch portion which fetches both a sequential side instruction sequences and a target side instruction sequences of a branching instruction;  
a cache controller which fetches instructions from

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a cache memory or from a main memory in response to a fetch request from said instruction fetch portion;

a memory bus access portion which accesses said main memory;

5 an instruction buffer which buffers instructions which have been fetched; and

a branching prediction portion which, prior to an execution of a branching instruction, performs a branching prediction for the branching instruction which is stored  
10 in said instruction buffer;

wherein, if the branching direction of said branching instruction is not yet determined, said cache controller performs a memory bus access to said main memory according to a branching direction predicted by the branching  
15 prediction portion.

13. The information processing device as claimed in Claim 12 wherein, while the branching direction of said branching instruction is not yet determined, if the cache  
20 controller has performed a cache miss with respect to an instruction in the predicted branching direction of said branching instruction, said cache controller performs the memory bus access to the main memory for an instruction fetch, and if said cache controller has performed a cache  
25 miss with respect to an instruction which is not in the predicted branching direction, said cache controller does not perform the memory bus access and stops the instruction

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fetch.

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14. The information processing device as claimed  
in Claim 12 wherein, while the branching direction of said  
5 branching instruction is not yet determined and the  
predicted branching direction of said branching  
instruction is the sequential side, in the event of said  
cache controller performing a cache miss with respect to  
said target side instruction, said cache controller does  
10 not perform a memory bus access and stops the instruction  
fetch.

15. The information processing device as claimed  
in Claim 12 wherein, while the branching direction of said  
15 branching instruction is not yet determined, said cache  
controller does not perform a memory bus access after a  
cache miss depending on the predicted branching direction  
of said branching instruction.

20 16. An information processing device, comprising:  
an instruction fetch portion which fetches both a  
sequential side instruction sequences and a target side  
instruction sequences of a branching instruction;

25 a cache controller which fetches instructions from  
a cache memory or from a main memory in response to a fetch  
request from said instruction fetch portion;

a memory bus access portion which accesses said main

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memory;

an instruction buffer which buffers instructions which have been fetched; and

5 a branching prediction portion which, prior to an execution of a branching instruction, performs a branching prediction of the branching instruction which is stored in said instruction buffer;

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10 wherein, if the branching direction of said branching instruction is not yet determined and said cache controller performs a cache miss with respect to an instruction fetch, said cache controller does not perform a memory bus access and stops the instruction fetch, and if said branching instruction has been determined and said cache controller performs a cache miss with respect to an instruction in  
15 the determined branching direction, said cache controller performs a memory bus access.

17. The information processing device as claimed in Claim 16 wherein, if the branching direction of said  
20 branching instruction is not yet determined, an instruction for which a cache hit has been made is prefetched and stored in said instruction buffer.

18. The information processing device as claimed  
25 in Claim 16 wherein, instructions are selected from either said instruction sequential side or instruction target side in said instruction buffer depending on the branching

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direction of the branching prediction portion, and decoded.

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